

Thermomechanical Analysis of High-Heat-Load Components for the Canted-Undulator Front End*

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Abstract

With the canted undulators operating at 200 mA at closed gap at the Advanced Photon Source in the future, the front end will receive 20.4 kW of total power and 282 kW/mrad² of peak power density. Thermal analysis of the front-end high-heat-load components becomes an essential part of the front-end design. An extensive study has been conducted in the thermal design of the photon shutters and fixed masks. A unique dog-bone-shaped cross-section design for the photon shutters is derived to relieve high stress in the corners. The dual-undulator x-ray beams are simulated at several locations on the fixed mask to ensure the worst possible case is considered. Stress analysis on the fixed mask revealed the maximum stress occurs when beam hits the intersection between the horizontal surface and the corner surface. The details of the analysis procedure are presented, and the failure criteria are discussed.

Keywords: front end, canted undulator, fixed mask, photon shutter, high heat load

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